Claims

What is claimed is:

1. An image processing apparatus having offset and optical black correction circuit coupled to receive a control signal having a first and second phase and an optical black signal from a charge coupled device, comprising:

a. a first circuit to sample the optical black signal at a predetermined reference voltage, the first circuit comprises

i. a correlated double sampler,

ii. a first and second programmable gain amplifier, the first programmable gain amplifier coupled to the correlated double sampler, and

iii. an adder coupled between the first and second programmable gain amplifiers, wherein the correction circuit couples to the adder to add the positive and negative difference to the optical black signal;

iv. an analog-to-digital converter coupled to the second programmable gain amplifier for converting the sampled signal into a digital signal;

b. a second circuit to correct the optical black offset coupled to the first circuit, the second circuit comprises

i. a reverse programmable gain amplifier coupled to the analog-to-digital converter to amplify the optical black level of the digital signal; and

ii. an integrator coupled to the reverse programmable gain amplifier to detect the optical black level of the digital signal; wherein the integrator couples to the adder.

2. The image processing apparatus as recited in claim 1, wherein the first programmable gain amplifier comprises

a first and second sampling circuit;

a differential amplifier having a first and second input and a first and second output, the first sampling circuit coupled to the first input, the second sampling circuit coupled to the second input; and

a first and second feedback circuit, the first feedback circuit coupled between the first input and the first output, the second feedback circuit coupled between the second input and the second output.

3. The image processing apparatus as recited in claim 2, wherein the first sampling circuit comprises

a first and second sampling switch;

a first sampling variable capacitor coupled to the first sampling switch;

a second sampling capacitor coupled to the second sampling switch;

a third feedback switch coupled between a power supply providing a common-mode voltage for the image processing apparatus and the first sampling variable capacitor; and

a fourth feedback switch coupled between a power supply providing a common-mode voltage for the image processing apparatus and the second sampling capacitor.

4. The image processing apparatus as recited in claim 3, wherein the first and second sampling switch closes on the first phase of the control signal and wherein the third and fourth sampling switch closes on the second phase of the control signal.

5. The image processing apparatus as recited in claim 3, wherein the second sampling circuit is equivalent to the first sampling circuit.

6. The image processing apparatus as recited in claim 2, wherein the first feedback circuit comprises:

a first and second feedback switch coupled to a power supply providing a common-mode voltage for the image processing apparatus;

a feedback capacitor coupled between the first and second feedback switches; and

a third feedback switch coupled between the feedback capacitor and the first output node of the amplifier, wherein the first output of the differential amplifier couples to the adder.

7. The image processing apparatus as recited in claim 6, wherein the first and second sampling switch closes on the first phase of the control signal, wherein the third sampling switch closes on the second phase of the control signal.

8. The image processing apparatus as recited in claim 6, wherein the second feedback circuit is equivalent to the first feedback circuit.

9. The image processing apparatus as recited in claim 1, wherein the first programmable gain amplifier comprises:

a sampling circuit;

an amplifier having an input and an output, the sampling circuit coupled to the input; and

a feedback circuit coupled between the input and the output.

10. The image processing apparatus as recited in claim 9, wherein the sampling circuit comprises:

a first and second sampling switch;

a first sampling variable capacitor coupled to the first sampling switch;

a second sampling capacitor coupled to the second sampling switch;

a third feedback switch coupled between a power supply providing a common-mode voltage for the image processing apparatus and the first sampling variable capacitor; and

a fourth feedback switch coupled between a power supply providing a common-mode voltage for the image processing apparatus and the second sampling capacitor.

11. The image processing apparatus as recited in claim 10, wherein the first and second sampling switch closes on the first phase of the control signal and wherein the third and fourth sampling switch closes on the second phase of the control signal.

12. The image processing apparatus as recited in claim 9, wherein the feedback circuit comprises:

a first and second feedback switch coupled to a power supply providing a common-mode voltage for the image processing apparatus;

a feedback capacitor coupled between the first and second feedback switches; and

a third feedback switch coupled between the feedback capacitor and the first output node of the amplifier, wherein the first output of the differential amplifier couples to the adder.

13. The image processing apparatus as recited in claim 12, wherein the first and second sampling switch closes on the first phase of the control signal, wherein the third sampling switch closes on the second phase of the control signal.

14. The image processing apparatus as recited in claim 1, wherein the second programmable gain amplifier comprises:

a first and second sampling circuit;

a differential amplifier having a first and second input and a first an second output, the first sampling circuit coupled to the first input, the second sampling circuit coupled to the second input; and

a first and second feedback circuit, the first feedback circuit coupled between the first input and the first output, the second feedback circuit coupled between the second input and the second output.

15. The image processing apparatus as recited in claim 14, wherein the first sampling circuit comprises:

a first sampling switch;

a sampling variable capacitor coupled to the first sampling switch; and

a second sampling switch coupled between the sampling variable capacitor and a power supply providing a common-mode voltage for the image processing apparatus.

16. The image processing apparatus as recited in claim 15, wherein the first sampling switch closes on the second phase of the control signal and the second sampling switch closes on the first phase of the control signal.

17. The image processing apparatus as recited in claim 14, wherein the second sampling circuit is equivalent to the first sampling circuit.

18. The image processing apparatus as recited in claim 14, wherein the first feedback circuit comprises:

a first and second feedback switch coupled to a power supply providing a common-mode voltage for the image processing apparatus;

a feedback capacitor coupled between the first and second feedback switches; and

a third feedback switch coupled between the feedback capacitor and the first output node of the amplifier, wherein the first output of the differential amplifier couples to the adder.

19. The image processing apparatus as recited in claim 14, wherein the first and second sampling switch closes on the first phase of the control signal, wherein the third sampling switch closes on the second phase of the control signal.

20. The image processing apparatus as recited in claim 14, wherein the second feedback circuit is equivalent to the first feedback circuit.

21. The image processing apparatus as recited in claim 1, wherein the second programmable gain amplifier comprises:

a sampling circuit;

an amplifier having an input and an output, the sampling circuit coupled to the input; and

a feedback circuit coupled between the input and the output.

22. The image processing apparatus as recited in claim 21, wherein the sampling circuit comprises:

a sampling switch; and

a first sampling variable capacitor coupled to the first sampling switch.

23. The image processing apparatus as recited in claim 22, wherein the sampling switch closes on the second phase of the control signal.

24. The image processing apparatus as recited in claim 21, wherein the feedback circuit comprises:

a first and second feedback switch coupled to a power supply providing a common-mode voltage for the image processing apparatus;

a feedback capacitor coupled between the first and second feedback switches; and

a third feedback switch coupled between the feedback capacitor and the first output node of the amplifier, wherein the first output of the differential amplifier couples to the adder.

25. The image processing apparatus as recited in claim 24, wherein the first and second sampling switch closes on the first phase of the control signal, wherein the third sampling switch closes on the second phase of the control signal.

26. An image processing apparatus having offset and optical black correction circuit coupled to receive a control signal having a first and second phase and an optical black signal from a charge coupled device, comprising:

a first circuit to sample the optical black signal at a predetermined reference voltage, the first circuit comprises

a correlated double sampler,

a first and second programmable gain amplifier, the first programmable gain amplifier coupled to the correlated double sampler, and

an adder coupled between the first and second programmable gain amplifiers, wherein the correction circuit couples to the adder to add the positive and negative difference to the optical black signal;

an analog-to-digital converter coupled to the second programmable gain amplifier for converting the sampled signal into a digital signal;

a second circuit to correct the optical black offset coupled to the first circuit, the second circuit comprises

a first and second sampling circuit;

a differential amplifier having a first and second input and a first an second output, the first sampling circuit coupled to the first input, the second sampling circuit coupled to the second input; and

a first and second feedback circuit, the first feedback circuit coupled between the first input and the first output, the second feedback circuit coupled between the second input and the second output.

27. The image processing apparatus as recited in claim 26, wherein the first sampling circuit comprises:

a first and second sampling switch, the first sampling switch coupled to a power supply providing a common-mode voltage for the image processing apparatus, second sampling switch coupled to a predetermined optical black value;

a third and fourth sampling switch; and

a sampling variable capacitor having a first and second end, the first and third sampling switches coupled to the first end of the sampling variable capacitor, the second and fourth switch coupled to the second end of the sampling variable capacitor.

28. The image processing apparatus as recited in claim 27, wherein the first and fourth sampling switch closes on the first phase of the control signal, wherein the second and third sampling switch closes on the second phase of the control signal.

29. The image processing apparatus as recited in claim 26, wherein the second sampling circuit is equivalent to the first sampling circuit.

30. The image processing apparatus as recited in claim 26, wherein the first feedback circuit comprises:

a feedback capacitor.

31. The image processing apparatus as recited in claim 30, wherein the second feedback circuit is equivalent to the first feedback circuit.

32. An image processing apparatus having offset and optical black correction circuit coupled to receive a control signal having a first and second phase and an optical black signal from a charge coupled device, comprising:

a first circuit to sample the optical black signal at a predetermined reference voltage, the first circuit comprises

a correlated double sampler,

a first and second programmable gain amplifier, the first programmable gain amplifier coupled to the correlated double sampler, and

an adder coupled between the first and second programmable gain amplifiers, wherein the correction circuit couples to the adder to add the positive and negative difference to the optical black signal;

an analog-to-digital converter coupled to the second programmable gain amplifier for converting the sampled signal into a digital signal;

a second circuit coupled to the first circuit to correct the optical black offset, the second circuit comprises:

a sampling circuit;

an amplifier having an input and an output, the sampling circuit coupled to the input; and

a feedback circuit coupled between the input and the output, the feedback circuit coupled to the adder.

33. The image processing apparatus as recited in claim 32, wherein the sampling circuit comprises:

a first and second sampling switch, the first sampling switch coupled to a power supply providing a common-mode voltage for the image processing apparatus, second sampling switch coupled to a predetermined optical black value;

a third and fourth sampling switch; and

a sampling variable capacitor having a first and second end, the first and third sampling switches coupled to the first end of the sampling variable capacitor, the second and fourth switch coupled to the second end of the sampling variable capacitor.

34. The image processing apparatus as recited in claim 33, wherein the first and fourth sampling switch closes on the first phase of the control signal, wherein the second and third sampling switch closes on the second phase of the control signal.

35. The image processing apparatus as recited in claim 32, wherein the feedback circuit comprises a feedback capacitor.

36. An image processing method comprising the steps of:

converting a signal of reflected light off of an object photoelectrically to obtain an optical black signal;

generating a predetermined reference voltage;

clamping the optical black signal to a predetermined reference voltage;

amplifying the optical black signal by a first gain of a first programmable gain amplifier;

amplifying the optical black signal by a second gain of a second programmable gain amplifier;

feeding back the amplified signal to a reverse programmable gain amplifier;

amplifying the optical black signal by the inverse of the second gain; and

adding the amplified optical black signal to the optical black signal after the first programmable gain amplifier.